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EXAMINER	
JACOB, OOMMEN	

ART UNIT	PAPER NUMBER
2613	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/581,037	TOMITA ET AL.	
	Examiner	Art Unit	
	OOMMEN JACOB	2613	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _28 December 2006_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-20_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-20_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _30 May 2006_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _08/29/2006_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claims 10 and 20 are objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim multiple dependent claim shall not serve as a basis for any other multiple dependent claim. See MPEP § 608.01(n) Claims 10 and 20 are multi dependent Claims that depend on multi dependent Claims 8 and 18 respectively.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

1. Claims 3 and 13 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 3 and 13, line 10, contains the limitation "at the same time". Applicant specification page 26 lines 21-25 discloses a time delay of 'T' between the orthogonal components 301 and 302. Therefore it is unclear as to how a phase difference can be applied to the two orthogonal components at the same time, since one component reaches the phase modulator after time period 'T'. For advance prosecution the

examiner interprets the limitation “at same time”, as “in same step”.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-3 and 11-13 rejected under 35 U.S.C. 102(b) as being anticipated by Bethune [US PAT NO: 6188768].

As per Claim 1

Bethune teaches a communication system (Bethune Fig 2) comprising:

a transmission path for serving as a transmission medium of light (Bethune Fig 2 item 30); a first station (Bethune Fig 2 item 10) having means for emitting time-divided optical pulses into the transmission path (Bethune Fig 2 shows pulses P1 and P2 leaving PBS2, separated by delay caused on P2 by item delay stage 18) and measuring a phase difference between the optical pulses returning from the transmission path (Bethune Col 4 lines 47-64 discloses deterministically directing photons based on phase difference. This implies determination of phase for directing photons); and a second station (Bethune Fig 2 item 20) having means for reversing traveling directions of the optical pulses (Bethune Col 4 lines 55-58), means for producing the phase difference, corresponding to a value of a random number bit to be transmitted, between the time- divided optical pulses (Bethune Fig 2 and Col 7 lines 32-

46 discloses phase modulator PM2 for applying phase shifts between the pulses, corresponding to bit values to be coded. Base for the phase shift is chosen randomly by sender and receiver), means for splitting each entering optical pulse into orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57) and producing a 180-degree phase difference between the orthogonally polarized components (Bethune Col 7 lines 33-37 discloses phases of 0 and π or π/2 and 3 π/2, which is a phase difference of π), means for rotating each polarization direction by 90 degrees (Bethune Col 6 lines 11-15 discloses that faraday mirror FM 22 rotates polarization of pulses by 90 degrees), and means for combining the orthogonally polarized components and reemitting the optical pulses into the transmission path (Bethune Col 9 lines 9-11).

As per Claim 2

Bethune further teaches a communication system, wherein a phase modulator is used as the means for producing the phase difference (Bethune Fig 2 items PM1 And PM2 are phase modulators), and by varying driving voltage to the phase modulator, the 180-degree phase difference is produced between the orthogonally polarized components (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation).

As per Claim 3

Bethune further teaches a communication system, wherein a single phase modulator is used as the means for producing the phase difference corresponding to the value of the random number bit to be transmitted and the means for producing the 180-degree phase difference between the orthogonally polarized components (Bethune

Fig 2 shows single phase modulator PM2 for producing phase difference and coding of bits), and by temporally varying driving voltage (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation), the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time (Bethune Col 7 lines 32-46 discloses selection of basis for modulation and the coding of the bits inside PM2. A total phase shift for pulse takes place inside PM2 in one step).

<u>As per Claim 10</u>

Bethune further teaches a communication system, wherein the second station has means for attenuating intensity of each optical pulse to include no more than 1 photon per bit when reemitting the optical pulses into the transmission path after combining the orthogonally polarized components (Bethune Col 5 lines 60-66 discloses attenuator for single photon pulse to be returned), so that a quantum cryptographic key is distributed (Bethune Col 1 lines 5-10 discloses cryptography using photons).

<u>As per Claim 11</u>

Bethune teaches a communication method (Bethune Fig 2) comprising the steps of:

causing a first station (Bethune Fig 2 item 10) to emit time-divided optical pulses into (Bethune Fig 2 shows pulses P1 and P2 leaving PBS2, separated by delay caused on P2 by item delay stage 18) a transmission path (Bethune Fig 2 item 30) and measure a phase difference between the optical pulses returning from the transmission

path (Bethune Col 4 lines 47-64 discloses deterministically directing photons based on phase difference. This implies determination of phase for directing photons); and causing a second station (Bethune Fig 2 item 20) to combine orthogonally polarized components of each optical pulse and reemit the optical pulses into the transmission path (Bethune Col 9 lines 9-11), wherein the second station has the transmission path for serving as a transmission medium of light (Bethune Fig 2 item 30, is connected to both stations 10 and 20), means for reversing a traveling direction of the optical pulses (Bethune Col 4 lines 55-58), means for producing the phase difference corresponding to a value of a random number bit to be transmitted, between the time- divided optical pulses (Bethune Fig 2 and Col 7 lines 32-46 discloses phase modulator PM2 for applying phase shifts between the pulses, corresponding to bit values to be coded. Base for the phase shift is chosen randomly by sender and receiver), means for splitting the entering optical pulse into the orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57) and producing a 180-degree phase difference between the orthogonally polarized components (Bethune Col 7 lines 33-37 discloses phases of 0 and π or π/2 and 3 π/2, which is a phase difference of π), means for rotating polarization direction of each polarized component by 90 degrees (Bethune Col 6 lines 11-15 discloses that faraday mirror FM 22 rotates polarization of pulses by 90 degrees).

As per Claim 12

Bethune further teaches a communication method, wherein a phase modulator is used as the means for producing the phase difference (Bethune Fig 2 items PM1 And PM2 are phase modulators), and by varying driving voltage to the phase modulator, the

180-degree phase difference is produced between the orthogonally polarized components (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation).

As per Claim 13

Bethune further teaches a communication method, wherein a single phase modulator is used as the means for producing the phase difference corresponding to the value of the random number bit to be transmitted and the means for producing the 180-degree phase difference between the orthogonally polarized components (Bethune Fig 2 shows single phase modulator PM2 for producing phase difference and coding of bits), and by temporally varying driving voltage (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation), the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced at the same time (Bethune Col 7 lines 32-46 discloses selection of basis for modulation and the coding of the bits inside PM2. A total phase shift for pulse takes place inside PM2, in one step).

As per Claim 20

Bethune further teaches a communication method, wherein the second station has means for attenuating intensity of each optical pulse to include no more than 1 photon per bit when reemitting the optical pulses into the transmission path after combining the orthogonally polarized components (Bethune Col 5 lines 60-66 discloses

attenuator for single photon pulse to be returned), so that a quantum cryptographic key is distributed (Bethune Col 1 lines 5-10 discloses cryptography using photons).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 4-8 and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bethune [US PAT NO: 6188768] in view of Negami [US PAT NO: 5471545].

As per Claim 4

Bethune further teaches a communication system, wherein after each entering optical pulse is split into orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57), the split polarized components are input to different terminals of a phase modulator (Bethune Fig 5A shows HP1 And VP1 entering two terminals of PM2), and the polarization directions thereof are rotated by 90 degrees (Bethune Col 6 lines 11-15 discloses that faraday mirror FM 22 rotates polarization of pulses by 90 degrees), and then the split polarized components are recombined (Bethune Col 9 lines 9-11).

Bethune does not expressly disclose rotating the polarization directions after the phase difference is produced there between.

Negami teaches rotating the polarization directions after the phase difference is produced there between (Negami Fig 1 shows polarization modulating section after the phase changing section).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the phase modulation and encryption method disclosed in Bethune, by integrating the method of phase modulation and polarization control as taught by Negami.

The motivation for the combination would be to effectively modulate light without requiring a process of regulating state of polarization of light incident (Negami Col 2 lines 45-48).

As per Claim 5

Bethune in view of Negami further teaches a communication system, wherein after each entering optical pulses is split into the orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57), distances along which the split polarized components propagate before entering the phase modulator are set to be different for each polarized component (Bethune Col 8 line 65-Col 9 line 8 discloses the advantages of setting distances traveled to the phase modulator same. This implies the method of setting different distances were considered, and have different time and phase variations for both components), and by temporally varying driving voltage (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation), the phase difference corresponding to the value of the random number bit and the 180-degree phase

difference between the orthogonally polarized components are produced) at the same time (Bethune Col 7 lines 32-46 discloses selection of basis for modulation and the coding of the bits inside PM2. A total phase shift for pulse takes place inside PM2).

<u>As per Claim 6</u>

Bethune in view of Negami further teaches a communication system, wherein after each entering optical pulses is split into the orthogonally polarized components, optical paths along which the split polarized components propagate before entering the different terminals of the phase modulator are composed of a polarization-maintaining optical fiber (Bethune Col 8 lines 1-10 disclose polarization maintaining fibers).

<u>As per Claim 7</u>

Bethune in view of Negami further teaches a communication system, wherein by orienting a polarizing axis of the polarization- maintaining optical fiber along electric-field vectors of the orthogonally polarized components of the entering optical pulse (Negami Col 5 lines 35-40 discloses axis of polarization of incident light parallel (in orientation) with stress applied to path. Col 6 lines 35-38 discloses piezoelectric to apply stress. Hence orientation of axis of polarization will be parallel to electric field caused by the piezoelectric), the split polarized components are combined with their polarization directions rotated by 90 degrees (Bethune Col 9 lines 10-15).

<u>As per Claim 8</u>

Bethune in view of Negami further teaches a communication system, wherein a Faraday rotator is used as the means for producing the 180-degree phase difference between the orthogonally polarized components and the means for rotating each

polarization direction by 90 degrees (Bethune Fig 2 item FM2, Col 4 lines 58-59 discloses Faraday rotator in the Faraday mirror for producing phase difference in the PM2. Col 9 lines 9-15 disclose that FM2 causes signals to have orthogonal polarization, compared to when they entered).

As per Claim 14

Bethune further teaches a communication method, wherein after each entering optical pulse is split into orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57), the split polarized components are input to different terminals of a phase modulator (Bethune Fig 5A shows HP1 And VP1 entering two terminals of PM2), and the polarization directions thereof are rotated by 90 degrees (Bethune Col 6 lines 11-15 discloses that faraday mirror FM 22 rotates polarization of pulses by 90 degrees), and then the split polarized components are recombined (Bethune Col 9 lines 9-11).

Bethune does not expressly disclose rotating the polarization directions after the phase difference is produced there between.

Negami teaches disclose rotating the polarization directions, after the phase difference is produced there between (Negami Fig 1 shows polarization modulating section after the phase changing section).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the phase modulation and encryption method disclosed in Bethune, by integrating the method of phase modulation and polarization control as taught by Negami.

The motivation for the combination would be to effectively modulate light without requiring a process of regulating state of polarization of light incident (Negami Col 2 lines 45-48).

As per Claim 15

Bethune in view of Negami further teaches a communication method, wherein after each entering optical pulses is split into the orthogonally polarized components (Bethune Fig 5A and Col 8 lines 55-57), distances along which the split polarized components propagate before entering the phase modulator are set to be different for each polarized component (Bethune Col 8 line 65-Col 9 line 8 discloses the advantages of setting distances traveled to the phase modulator same. This implies the method of setting different distances were considered, and have different time and phase variations for both components), and by temporally varying driving voltage (Bethune Col 2 lines 60-67 discloses proton exchange phase modulators, that inherently require drive voltages applied to electrodes for phase modulation), the phase difference corresponding to the value of the random number bit and the 180-degree phase difference between the orthogonally polarized components are produced) at the same time (Bethune Col 7 lines 32-46 discloses selection of basis for modulation and the coding of the bits inside PM2. A total phase shift for pulse takes place inside PM2).

As per Claim 16

Bethune in view of Negami further teaches a communication method, wherein after each entering optical pulses is split into the orthogonally polarized components, optical paths along which the split polarized components propagate before entering the

different terminals of the phase modulator are composed of a polarization-maintaining optical fiber (Bethune Col 8 lines 1-10 disclose polarization maintaining fibers).

As per Claim 17

Bethune in view of Negami further teaches a communication method, wherein by orienting a polarizing axis of the polarization- maintaining optical fiber along electric-field vectors of the orthogonally polarized components of the entering optical pulse (Negami Col 5 lines 35-40 discloses axis of polarization of incident light parallel (in orientation) with stress applied to path. Col 6 lines 35-38 discloses piezoelectric to apply stress. Hence orientation of axis of polarization will be parallel to electric field caused by the piezoelectric), the split polarized components are combined with their polarization directions rotated by 90 degrees (Bethune Col 9 lines 10-15).

As per Claim 18

Bethune in view of Negami further teaches a communication method, wherein a Faraday rotator is used as the means for producing the 180-degree phase difference between the orthogonally polarized components and the means for rotating each polarization direction by 90 degrees (Bethune Fig 2 item FM2, Col 4 lines 58-59 discloses Faraday rotator in the Faraday mirror for producing phase difference in the PM2. Col 9 lines 9-15 disclose that FM2 causes signals to have orthogonal polarization, compared to when they entered).

4. Claims 9 and 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Bethune [US PAT NO: 6188768] in view of Sedlmayr [US PUB NO: 2004/0114237].

As per Claim 9

Bethune further teaches a communication system, wherein a polarization beam splitter is used as the means for splitting each of the optical pulses into the orthogonal components and the means for combining the orthogonal components (Bethune Fig 5A item PBS3 item),

Bethune does not expressly teach an antireflection termination is provided at a port, from which a polarized component resulting from a deviation from the polarization rotation angle of 90 degrees is output, of the polarization beam splitter.

Sedlmayr teaches teach an antireflection termination is provided at a port (Sedlmayr ¶0274 lines 8-10 discloses transmission of one component only), from which a polarized component resulting from a deviation from the polarization rotation angle of 90 degrees is output, of the polarization beam splitter (Sedlmayr ¶0297 and Fig 8A, discloses deflection of one polarization by a polarizing analyzer).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the phase modulation and encryption method disclosed in Bethune, by integrating the method of beam splitting disclosed by Sedlmayr.

The motivation would have been to provide a polarizing beam splitter that is less costly to produce and weigh less than a cube polarizer (Sedlmayr ¶0274 lines 19-22).

As per Claim 19

Bethune further teaches a communication method, wherein a polarization beam splitter is used as the means for splitting each of the optical pulses into the orthogonal

components and the means for combining the orthogonal components (Bethune Fig 5A item PBS3 item).

Bethune does not expressly teach an antireflection termination is provided at a port, from which a polarized component resulting from a deviation from the polarization rotation angle of 90 degrees is output, of the polarization beam splitter.

Sedlmayr teaches teach an antireflection termination is provided at a port (Sedlmayr ¶0274 lines 8-10 discloses transmission of one component only), from which a polarized component resulting from a deviation from the polarization rotation angle of 90 degrees is output, of the polarization beam splitter (Sedlmayr ¶0297 and Fig 8A, discloses deflection of one polarization by a polarizing analyzer)

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the phase modulation and encryption method disclosed in Bethune, y integrating the method of beam splitting disclosed by Sedlmayr.

The motivation would have been to provide a polarizing beam splitter that is less costly to produce and weigh less than a cube polarizer (Sedlmayr ¶0274 lines 19-22).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to OOMMEN JACOB whose telephone number is (571) 270-5166. The examiner can normally be reached on Monday – Friday, 8:00 a.m. – 5:00 p.m., EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, KEN VANDERPUYE can be reached on (571) 272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/OJ/

/Kenneth N Vanderpuye/
Supervisory Patent Examiner, Art Unit 2613